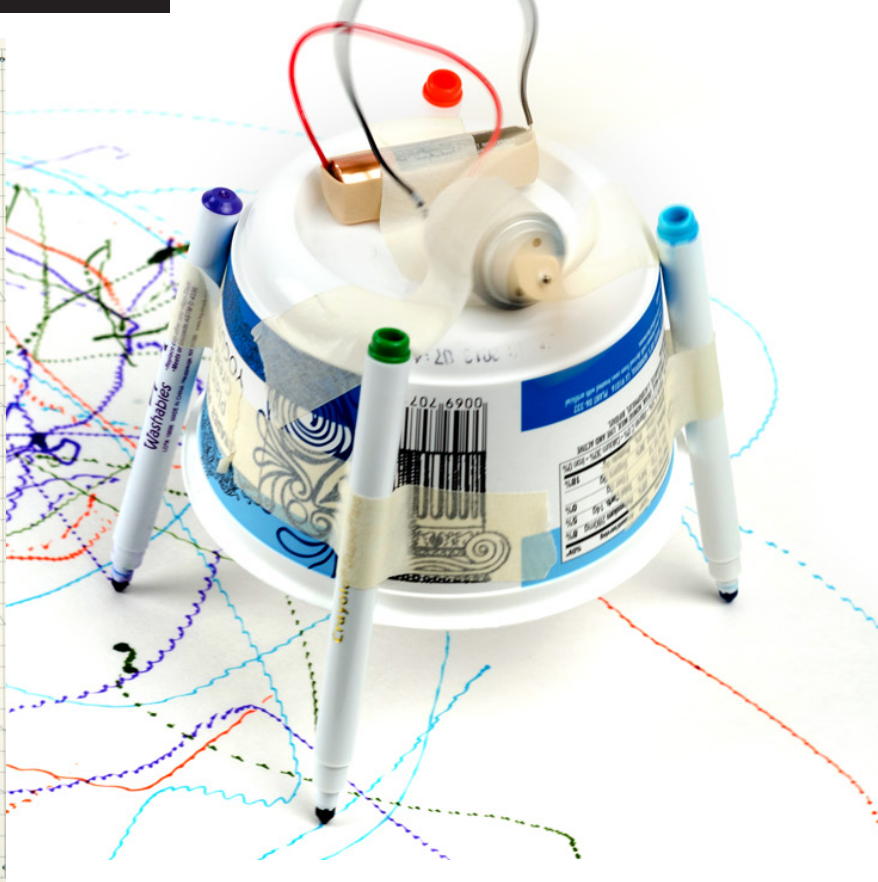
SCRIBBLING MACHINES

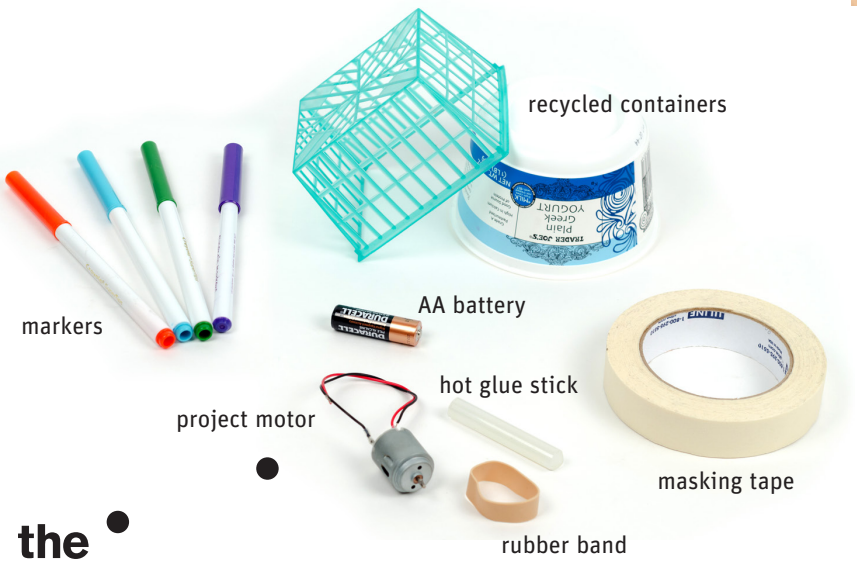
AFTER-SCHOOL EDUCATOR GUIDE

Scribbling Machines are motorized contraptions that move in unusual ways and leave a mark to trace their paths. This activity is an especially effective way to introduce young people to the practices of iterative design and engineering. The simple recycled materials, markers, and masking tape used for scribbling machines make it easy to get started and easy to make changes or start over without sacrificing a lot of hard work. While building, students will often notice differences in the movement of their machine and the marks it makes with every small adjustment to its construction. Stabilization, balance, weight, vibration and kinetic motion are all principles that students investigate while testing and adjusting their creations. Scribbling Machines are also fundamentally sculptural, and many students integrate narrative and storytelling while creating. Often the machine's character reveals itself either through the making process or afterwards during group reflection or journal writing.

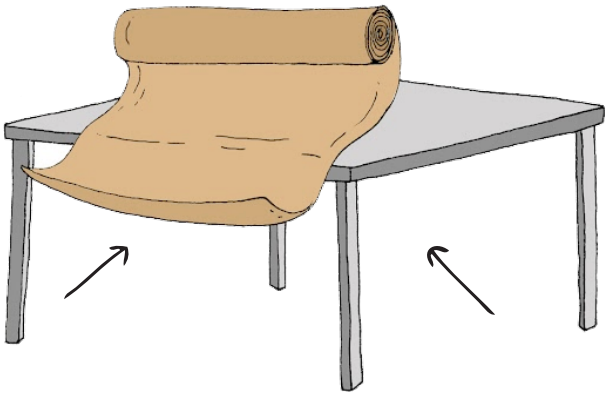


MATERIALS AND SET-UP

Collect these things:



Try adding: Clothespins, Popsicle sticks, pipe cleaners, wire, nuts, washers, or other small weights, wire stripper, scissors, small screwdriver, googly eyes.



Covering all the tables with butcher paper means scribbling machines can be tested anywhere, at any time.

the tinkering studio

exploratorium

OPENING DISCUSSION PROMPTS

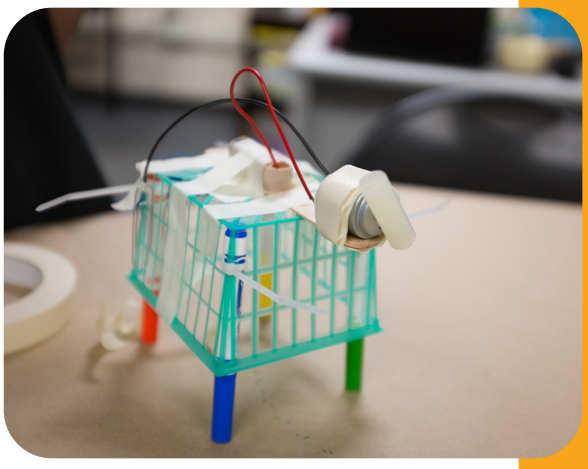
If students have had prior experience with Circuit Boards, we usually start by referencing these investigations and pointing out that we'll be working with the same small motors they experimented with on the boards. Having a small set of circuit boards available will also help young people make connections between these activities. If any students have not had previous experience with circuits, you can ask one of the returning students to demonstrate a simple circuit for them.

Scribbling Machines are a great opportunity for emphasizing the process of iteration and the importance of multiple drafts. We've found that students benefit from a discussion that sets up the activity as an exercise in ideas rather than as a challenge to produce a polished result. Being explicit about why we chose materials that are impermanent and allow us to work quickly (like masking tape, recycled cups and pipe cleaners) can help set this tone. We also show examples of scribbling machines that are somewhat faulty or in-progress to model the thinking done while building. Some discussion prompt ideas:

What are machines and robots? What kinds of everyday machines come to mind when you think of objects that move or perform a task all on their own? If you could invent a machine that would improve your life or someone else's, what would it be?

What were you investigating the last time you worked with circuits? What did you discover about how circuits are built in order to power something? What new questions do you have about how circuits or electricity work?

When showing an example of a scribbling machine for the whole group, you might ask students to observe how it moves. "What do you notice about the machine?" "Why is it moving that way?" You can also do some real time adjusting of the machine to change the movement, encouraging students to inquire about how and why it may be moving in a new way.

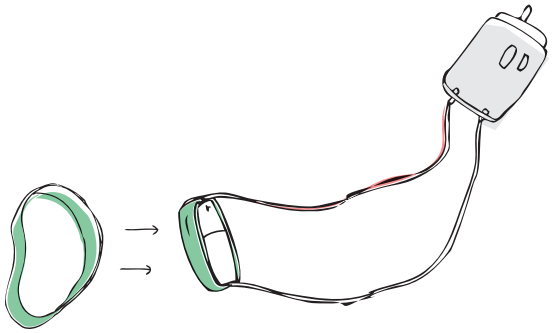


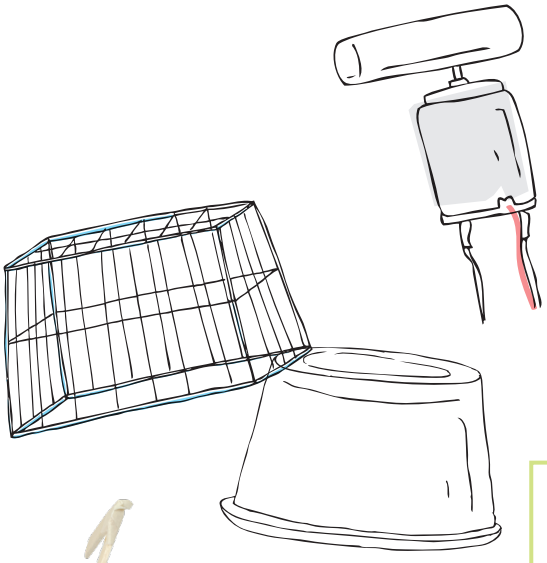
For the love of words

The words we use shape the intellectual space young people are working in. Often we will use the language of inventors, artists, designers, or engineers to help students get into the spirit of making and tinkering with their scribbling machines. This might include saying something like, "You all will be stepping into the roles of inventors and engineers today!" or "Watch how the motors move and make discoveries by experimenting with making it dance and draw in different ways." or "Mirá que huellas tan bonitas deja con el marcador." Or "I love that design you are working on." We make efforts to encourage both students and educators to use multiple languages within the space.

GETTING STARTED

Connect the motor to the battery: a broccoli rubber band is helpful for keeping the leads attached to the motor while still allowing you to disconnect them when you want to change the motor's position.





Get to know your motor: Let youth spend some time noticing the movement of the motor before adding a glue stick to offset it. This is a good time to look at models and think about how the position of the glue stick might be affecting their movement.

Use a nail or small screwdriver to poke a hole for the glue stick. Some kids may need help with this.

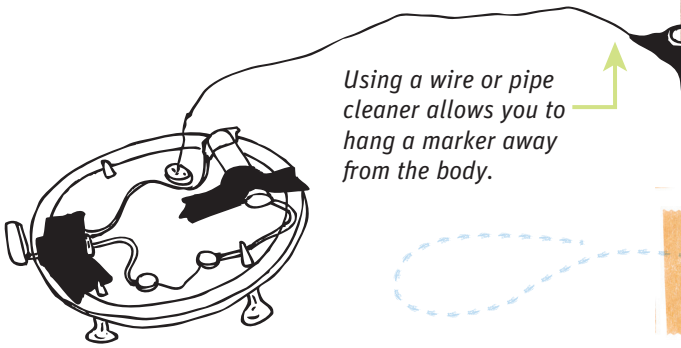
Find or build a base and attach your offset motor to it: try a strawberry basket, yogurt container, or other recyclable container.

Attach one or more markers to trace the jittering movement of your scribbling machine. Turn it on and make some scribbles!

Get excited about the marks that the machines make on the paper! We encourage students to notice the different patterns and think about what might be causing them.

MULTIPLE PATHWAYS

Some students may be interested in starting by building the structure of their machine out of the available materials, or coloring the structure with the pens. Others may want to start with the battery and motor to get it working and moving. We encourage these multiple pathways. Sometimes our role might be to help them think about how to transition or connect one to the other. For example, if a student has been working on the structure for some time but hasn't yet engaged with the batteries/motor, we might ask: "Where do you think the motor might go?" Sometimes the simple act of bringing over the battery and motor will help students start making that connection. Or they might have a structure and a motor and battery but haven't figured out what to do next. In this case you might physically show them that they could place the battery and motor on different parts of the body and then have them decide where they want them to go.



Using a wire or pipe cleaner allows you to hang a marker away from the body.

GOOD PROBLEMS

Some of the ways young people might feel stuck are also great opportunities to encourage testing, observation, and the sharing of ideas. Some of the common fruitful problems we've seen are discussed below.

Copying vs. Inspiration: There's no shame in copying something we like! We have found that though a students' machine may start out with an idea borrowed directly from an example or another student's project, they often quickly add their own flair and take it in a new and interesting direction. We often try to reframe concerns about copying as examples of inspiration or the borrowing of ideas.

"I can't" Some of the physical tasks involved deserve their own attention and support: Getting the rubber band around the battery, tearing masking tape, slipping wires under the rubber band, and attaching the glue stick to the motor are all good skills to help students work on rather than do for them.

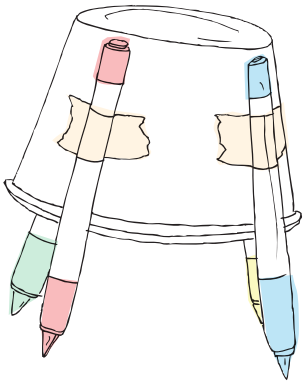
Try it out: If students are building and using lots of tape but haven't turned on the motor, they might need to be reminded to turn it on and test out the movement. If you are helping someone adjust or stabilize their machine, you might look for the right moment to say, "OK, lets see if that helps."

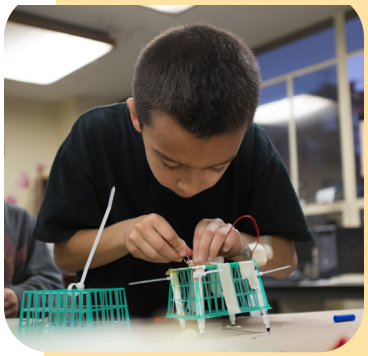
What if? If their machine doesn't work the way they planned, use "what if's" to help them imagine and try out multiple possibilities.

Balance: Issues with balance can be an opportunity to think about counter-weight and other ways of creating stability.

Bumper Bots: It's common for scribbling machines to bump into each other on the table. While this could be a source of tension or frustration, we try to create a playful atmosphere where people marvel at one another's machines or joke about how they are "dancing with each other." Statements like "The machine is coming to check out the friend you are building for it!" can help draw connections between students' machines, ideas and selves.

Comparisons: Sometimes one student's excitement and success can cause others to compare their own progress and feel discouraged. We've found that responding to excitement with questions about how they came to their design, or what problems they tackled along the way, can help deepen the collective thinking and appreciation across projects.





Plans: When students call us over to ask for help, we tend to ask something like: "What are you working on?" or "what are you trying to do?" to first get a sense of their thinking and goals. This also creates an opportunity for them to voice and talk through their ideas out loud.

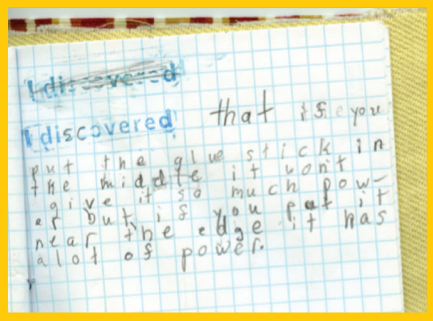
"I'm not good at this." Getting stuck or frustrated can be emotional. Sometimes simply sitting with students and holding a piece down while they tape might help their process. Drawing attention to all the work they did already and supporting them to troubleshoot can help bring them back into the flow of work.

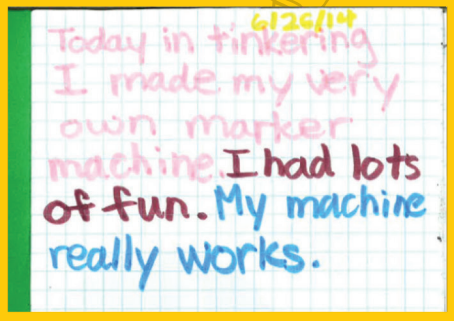
Science journal prompts:

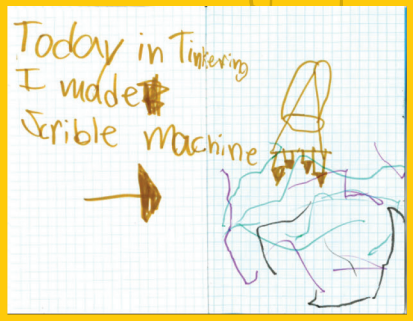
Consistent with the notion of science journals being a place to record the histories of ideas, Scribbling Machines are a perfect opportunity for documenting machines that may be taken apart at the end of the day. We often encourage students to draw or write about their work with questions such as:

- How did your scribbling machine come to be? Draw or write about some of the different stages your machine went through in the process of being made.
- What kind of scribbles does your machine specialize in? What about your design makes it draw that way?
- Give your machine a name and a character and tell us about it.
- If a friend wanted to make your scribbling machine, what would they need to know?
- What kind of machine would you like to create next?

SCIENCE JOURNALS IN ACTION







Noticing Learning in Science Journals:

These images highlight the sense of pride that students had in their inventions (and the fact that they "really work"!). This sense of pride that can be further deepened through the process of drawing and writing in their science journals. The student's description of her discovery in the first image also illustrates the intersections between literacy and science learning. In this case, the journal provided a context to synthesize and express new understandings in ways that authentically support future investigations. Similar to the circuit boards, students' diagramming of the machine itself also reflect continued inquiry into how and why things work the way they do. Finally, the student's "scribbles" on the paper speak to the artistic and playful aspects of this activity, which we purposely welcome into journal writing.

FACILITATOR DEBRIEF PROMPTS

- Which designs or ideas seemed to be shared or borrowed across the room?
- Did anyone use the motors in a way you didn't expect or haven't seen before?
- Was there any talk amongst students and/or staff about how the principles or practices involved in making scribbling machines relate to everyday life, professions or school?
- Did you notice any "good problems" that helped deepen student learning?
- What were some challenging moments today? Writing about these challenges or discussing them with others can help you brainstorm future strategies for facilitation or program design.

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